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## THE SAN JUAN DISTRICT, PORTO RICO: ITS PHYSIOGRAPHY AND GEOLOGY

D. R. SEMMES. **The Geology of the San Juan District, Porto Rico.** Map, diags., ills., bibliogr. Scientific Survey of Porto Rico and the Virgin Islands, Vol. 1, Part 1, pp. 33-110. N. Y. Acad. of Sci., 1919.

The above geological report, published by the New York Academy of Science as part of its "Scientific survey of Porto Rico and the Virgin Islands," begun in 1914 and conducted jointly with the Porto Rico government, deserves the attention of geographers if only for the excellent quality of its second paragraph. The first paragraph briefly explains that the district described lies in the northern half of the island, of which it is typical, the second compactly states: "The physiographic history of the San Juan district is that of a complex mountainous oldland, which has been peneplained, partially submerged, overlapped by a coastal plain, uplifted, maturely dissected, again slightly submerged and partially uplifted, erosion continuing in the interior from the time of the first uplift." Thus the reader immediately acquires at the outset a general concept of the area studied, upon which a multitude of refining details are embroidered in the following pages. As the object of the study was geological, the quoted statement is phrased historically; but a geographical paraphrase can be easily prepared from it.

The mountainous oldland is "merely the eroded crest of a submerged mountain range of great complexity and magnitude," its axial altitude being about 2,500 feet. In the interior it has "attained the maximum ruggedness characteristic of a fully mature stage in topographic development;" its form there is "predominantly that of the ridge or *cuchilla* [knife] type," the minutely ravined slopes of the ridges descending at angles of 30° or 40° into close-placed, V-shaped valleys of dendritic (insequent?) arrangement, at the head of which the streams still have cascades. Yet a broad view shows that the innumerable ridges possess a general accordance of crest-line altitudes, as if they had been carved in a possible uplifted peneplain, of which occasional undissected uplands are taken to be remnants. Surmounting elevations, from 3,600 to 3,800 feet in altitude, are regarded as monadnocks. The rocks of the oldland yield various metals, including gold and platinum, in small quantities. Of special significance in the rock composition is the small proportion of quartz. Weathering gives rise to a very impervious clayey soil. It is to this fact that the remarkable stability of the soil mantle may be attributed. Hillsides that slope as steeply as 40° are susceptible of cultivation with little loss of soil. The northward decline of the mountains leads to their disappearance with decreasing relief beneath the coastal plain; but their marginal altitudes vary so greatly that the peneplain thereabouts was either not well developed, or has suffered later warping.

The coastal plain has a belted relief. Adjoining part of the mountain border is a longitudinal inner lowland, excavated along the strike of weak clays and marls, the basal members of the coastal plain series. Next comes a dissected *cuesta* maintained by relatively resistant limestones, in part of coral reef origin. Where best developed, the *cuesta* inface rises abruptly from the inner lowland. The *cuesta* upland is elaborately dissected, showing many small, isolated, or "haystack" hills rising over plain areas that stand in terrace-like arrangement at lower and lower levels toward the coast. There are many caves in the limestone hills, some of which contain bat guano, locally used as a fertilizer. In consequence of slight changes of level since its erosion, the dissected coastal plain has an irregular outer margin, which is adjoined by lowlands or *playa* plains several miles in width, formed of outwashed detritus. Their surface being only a few feet above sea level, they are occasionally flooded by heavy rains and on-shore hurricanes. The *playa* plains are occasionally interrupted by low, isolated outliers of the partly submerged coastal plain; their outer margin is bordered along the shore by a belt of low sand dunes which, formed as an off-shore sand reef, may have preceded and aided the formation of the *playa* plains. Until recently the *playa* plains were largely covered with swamp, but, "since the value of the land has been recognized for sugar-cane production, all the available areas have been drained and now constitute the most productive and valuable lands on the island." The city of San Juan lies on the western extremity of an offshore belt of consolidated sand dunes that encloses a lagoon harbor.

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